

Tulane Center for Cardiovascular Health
Gerald S. Berenson, Director & Principal Investigator
Overview - The Bogalusa Heart Study

The Bogalusa Heart Study was funded by the National Heart, Lung and Blood Institute to study the early natural history of arteriosclerosis (coronary artery disease and essential hypertension, the major adult heart diseases) from 1992-2003. Funding to continue genetic studies are pending. Funds from the National Institute on Aging are currently supporting studies on aging and longevity in the community study.

The Bogalusa Heart Study has become one of the longest and most detailed studies of children and young adults in the world. In its 32nd year, it is the only long-term research program studying a bi-racial (black-white) population in a total and rural community. The oldest subjects are now entering middle age and some subjects have been followed for 30 years with repeated (up to 11 times) measurements beginning in childhood. A major strength of the study is the capability of studying ethnic and gender contrasts over a long period of time.

To complement the long-term observations, over 160 substudies have been conducted in special areas like lifestyles of diet and tobacco use, socio-economic evaluations, high blood pressure, cholesterol and lipoproteins, genetic markers, diabetes and a study of newborns. The numerous observations have provided scientific data for some 750 articles that have appeared in various medical journals in the United States and abroad. In addition, there have been three textbooks summarizing the data in Bogalusa along with a number of monographs.

Secular trend studies have documented the nation's epidemic of obesity. Children in Bogalusa are on an average 5kg heavier without being taller than when the study began in 1972. Of major importance, autopsy studies have documented atherosclerotic coronary artery disease presents even in childhood and has a strong and highly significant correlation with clinical risk factors. Coronary atherosclerotic lesions accelerate in the third decade of life and are related to multiple risk factors, as in the metabolic syndrome. The long-term existence of this study and its success can be attributed to the support from the Bogalusa community and its continued acceptance for the study.

Lessons from the Bogalusa Heart Study, like tobacco and alcohol use and poor nutrition, have inspired research on "Health Ahead/Heart Smart" – a cardiovascular health promotion program for elementary school children. This is a comprehensive health education program, not only to prevent heart disease, but also to address the social problems of young individuals. The education program attempts to prevent drug use, alcohol abuse, smoking, teenage pregnancy, dropouts and even violent behavior. Health education of elementary school children is being continued as major outgrowth of the Bogalusa Heart Study.

Evolution of Cardiovascular Risk with Normal Aging
Principal Investigator: Gerald S. Berenson, M.D.
National Institute on Aging – AG16592
Dates: May 15, 2000 - August 31, 2005

The Bogalusa Heart Study – Aging Studies funded by the National Institute on Aging

The cardiovascular (C-V) system is one of the organ systems most affected by the aging process. Significant differences in C-V morbidity and mortality occur by race and gender that influence longevity. The proposed research involves a biracial (black-white) population that has been followed for C-V risk factors and lifestyles in the Bogalusa Heart Study over the past 25 years. The specific aim of the research is to characterize traits (intrinsic aging vs. The risk factor burden) in a population reaching middle age that influence the subclinical C-V disease process in normal aging. The extensive data base collected since childhood provides information related to silent underlying C-V disease and aging. The study cohort includes 1,200 individuals born between 1959 and 1969, who were examined at least four times since childhood. The cohort will be examined for: 1) C-V risk factor variables comprising obesity measures, blood pressure, lipids, lipoproteins, apolipoproteins, homocysteine, glucose, insulin, fibrinogen, plasminogen activator inhibitor 1, intercellular adhesion molecules -1, C-reactive protein, lipid peroxides and microalbuminuria; 2) lifestyle and psychosocial variables such as tobacco and alcohol use, physical activity, diet, and life change events; 3) subclinical changes of the heart and vasculature (outcome variables) observed by echo-Doppler measurements of cardiac-carotid structure and function and brachial and radial artery compliance; and 4) selected longevity-associated allele markers, like apoE. These variables (except for the allele markers) will be measured at two points in time, with a 3-year interval. In addition, a family history of longevity and health history information on study subjects and their parents and grandparents will be obtained to evaluate familial risk characteristics of the cohort. The proposed studies will provide insights into the interaction of normal aging and predisposing factors that influence the subclinical C-V disease process in a black-white population reaching middle age. Understanding the evolution of C-V risk in normal aging can lead to more rational programs for successful aging and longevity and C-V disease prevention.

Items:

2. **Dates:** May 15, 2000 – August 31, 2005

3. **Link to website:** www.som.tulane.edu/cardiohealth

4. **Suggested Key Words:**

Cardiovascular disease, C-V Risk Factors, Aging, Subclinical C-V Phenotypes, Bi-racial (black-white)

5. **Contact Person for Study:**

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Experimental Design - The Bogalusa Heart Study

Year	Preschool School														Post High School			
1973-74	0	2	3	4	5	6	7	8	9	10	11	12	13	14				
1976-77		3			5	6	7	8	9	10	11	12	13	14	15	16	17	
1978-79					5	6	7	8	9	10	11	12	13	14	15	16	17	18 19
1979-80																		18 -- 20
1981-82					5	6	7	8	9	10	11	12	13	14	15	16	17	
1982-83																		18 --- 23
1983-85					5	6	7	8	9	10	11	12	13	14	15	16	17	
1985-86																		18 ---- 26
1987-88					5	6	7	8	9	10	11	12	13	14	15	16	17	
1988-91																		18 ----- 32
1992-94					5	6	7	8	9	10	11	12	13	14	15	16	17	
1995-96																		18 ----- 38
1997-02		Sibship Screening for Genetic Study														12	-----	51
00-Date		Evolution of CV Risk with Normal Aging														18	-----	44

Study Variables: The Bogalusa Heart Study

1. Physiologic Phenotypes

Multiple Measurements (4-12 times since childhood)

- Weight, height and skinfolds
- Blood pressure
- Total cholesterol, triglycerides and lipoprotein cholesterol
- Insulin and glucose (after 1982)

Single Measurement

- Waist circumference
- Homocysteine
- PAI-1, fibrinogen and von Willebrand factor
- ApoB, ApoE, ApoA-I, LpA-I, LpA-I:A-II and Lp(a)
- C-peptide, IGF-1 and SMA-20 chemistry profile
- Microalbumin/creatinine in urine
- Hb A1C, C-Reactive Protein and E-selectin

2. Life Style: smoking, alcohol use, OC use, diet, physical activity and psycho-social behaviors

3. Demographics: race, age, sex, SES and parental history of CVD

4. Non-invasive Cardiac/Vascular Structure-Function Measurements

Echo-Doppler:

Carotid Artery IMT

Carotid Artery Elasticity (Ep and YEM)

Cardiac Structure/Function (Left Ventricular Mass/Geometry)

Pulse Wave Velocity

HDI: Large(C1) and Small(C2) Artery Elasticity Index

Pulsemetric: Brachial Distensibility

Colin: Pulse Wave Velocity, Augmentation Index, Ankle-Brachial Ratio

5. Hand Tremor Test

6. Genotype Data

Subjects and observations by linking 20 datasets from 1973-2002: The Bogalusa Heart Study

	White		Black		Total		
Times							
Screened	Indiv	Obs	Indiv	Obs	Indiv (%)		Obs
1	2949	2949	1492	1492	4441 (36.3)		4441
2	1504	3005	787	1574	2291 (18.7)		4579
3	1040	3120	562	1686	1602 (13.1)		4806
4	682	2728	489	1956	1171 (9.6)		4684
5	560	2800	395	1975	955 (7.8)		4775
6	380	2280	251	1506	631 (5.2)		3786
7	303	2121	171	1197	474 (3.9)		3318
8	194	1552	123	984	317 (2.6)		2536
9	122	1098	67	603	189 (1.5)		1701
10	72	720	37	370	109 (0.9)		1090
11	27	297	8	88	35 (0.3)		385
12	4	48	1	12	5 (0.0)		60
13	0	0	1	13	1 (0.0)		13
Total	7837	22718	4384	13456	<u>12221</u> (100)		<u>36174</u>

White cohort : 44.6% males and 55.4% females

Black cohort : 43.2% males and 56.8% females

Subjects by baseline age and number of screenings by linking 20 datasets in a subset with at least 2 times

Baseline Age (years)	Number of Times Screened					Total (%)
	2-3	4-5	6-7	8-9	10-13	
4	76	54	28	2	0	160 (2.1)
5	647	390	132	70	31	1270 (16.3)
6	825	462	175	27	2	1491 (19.2)
7	510	347	131	24	0	1012 (13.0)
8	383	132	110	80	30	735 (9.5)
9	261	146	93	39	7	546 (7.0)
10	244	118	88	42	6	498 (6.4)
11	146	125	91	65	32	459 (5.9)
12	213	116	90	58	10	487 (6.3)
13	219	89	73	28	0	408 (5.3)
14	125	87	56	54	31	353 (4.5)
15	118	37	25	17	1	198 (2.5)
16	59	8	4	0	0	71 (0.9)
17	61	12	8	0	0	81 (1.0)
Total	3887	2122	1104	506	150	<u>7769</u> (100)

Subjects by number of screenings and baseline age in a subset with at least 2 times in childhood and at least 2 times in adulthood during 1973-2002

Baseline Age (years)	Number of Times Screened				Total (%)
	4 - 5	6 - 7	8 - 9	10-13	
4	2	15	2	0	19 (1.1)
5	16	41	39	31	127 (7.1)
6	40	107	25	2	174 (9.7)
7	50	111	24	0	185 (10.3)
8	21	42	74	30	167 (9.3)
9	44	85	39	7	175 (9.8)
10	53	86	42	6	187 (10.4)
11	16	52	65	32	165 (9.2)
12	78	84	59	10	231 (12.9)
13	61	68	27	0	156 (8.7)
14	49	72	64	32	208 (11.6)
Total	421	763	460	150	<u>1794</u> (100)

Cohorts for Aging Studies:

Number of screening times of aging study cohort during 1973-2002

Times Screened	White		Black		Total	
	Indiv	Obs	Indiv	Obs	Indiv (%)	Obs
1	16	16	4	4	20 (1.5)	20
2	1	2	2	4	3 (0.0)	6
3	1	3	2	6	3 (0.0)	9
4	61	244	16	64	77 (5.7)	308
5	167	835	60	300	227 (16.9)	1135
6	184	1104	86	516	270 (20.1)	1620
7	179	1253	76	532	255 (18.9)	1785
8	134	1072	74	592	208 (15.5)	1664
9	95	855	45	405	140 (10.4)	1260
10	65	650	37	370	102 (7.6)	1020
11	27	292	8	88	35 (2.6)	380
12	4	48	1	12	5 (0.0)	60
13	0	0	1	13	1 (0.0)	13
Total	934	6374	412	2906	<u>1346</u> (100)	<u>9280</u>

White cohort : 416 (44.5%) males and 518 (55.5%) females

Black cohort : 164 (39.8%) males and 248 (60.2%) females

Cohorts for Genetic Studies:

Genetic Study Cohorts screened multiple times during 1973-2001

Times Screened	Unrelated		Sibling		Total	
	Indiv	Obs	Indiv	Obs	Indiv(%)	Obs
1	73	73	153	153	164(7.2)	164
2	79	158	174	348	182(8.0)	364
3	93	279	215	645	227(10.0)	681
4	229	916	229	916	376(16.6)	1504
5	276	1380	281	1405	433(19.1)	2165
6	221	1326	219	1314	343(15.1)	2058
7	163	1141	130	910	237(10.4)	1659
8	119	952	100	800	176(7.7)	1408
9	52	468	59	531	90(4.0)	810
10	26	260	28	280	40(1.8)	400
11	1	11	2	22	2(0.1)	22
12	1	12	1	12	1(0.0)	12
Total	<u>1333</u>	6976	<u>1591</u>	7336	2271*(100)	11247

* The number of individuals in total cohort is 2271=1333+1591-653 due to 653 siblings overlapped in both cohorts.

Number of Sib-Pairs by Race

Sibship Size	Sibships			Individuals			Sib-Pairs		
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	White	Black	Total	White	Black	Total	White	Black	Total
2	324	134	458	648	268	916	324	134	458
3	91	48	139	273	144	417	273	144	417
4	14	22	36	56	88	144	84	132	216
5	9	5	14	45	25	70	90	50	140
6	0	2	2	0	12	12	0	30	30
7	0	1	1	0	7	7	0	21	21
8	0	2	2	0	16	16	0	56	56
9	0	1	1	0	9	9	0	36	36
Total	438	215	653	1022	569	<u>1591</u>	771	603	<u>1374</u>

Genotype Data

Candidate genes on unrelated cohort

Gene	Polymorphism
Lipoprotein lipase***	Ser447Stop
Hepatic lipase**	C-514T
G-protein β 3	C825T
Adducin	Gly460Trp
Angiotensinogen	G-6A
Endothelial nitric oxide synthase***	Glu298Asp
β 1 adrenergic receptor**	Arg389Gly
β 2 adrenergic receptor*	Arg16Gly
β 3 adrenergic receptor*	Trp64Asp
Uncoupling protein 2	Ala55Val
Peroxisome proliferator-activated receptor γ *	Pro12Ala
ATP-binding Cassette transporter A1*	Arg219Lys
Paraoxanase 1*	Gln192Arg
Apo E ***	E2/E3/E4
Apo B	D/I
Calpain 10	D/I

*One paper published; **Two papers published;

***Three papers published

Distribution of Inter-Marker Space of 368 Markers Typed on the Sib-Pair Cohort

